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THE SOCIAL PARASITISM OF THE ANT *HARPAGOXENUS AMERICANUS*

By A. H. Sturtevant

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Harpagoxenus americanus was described by Emery (1895), from workers found by Pergande in a nest of *Leptothorax curvispinosus* Mayr at Washington, D. C., and from a single specimen collected by Schmitt at Beatty, Pa. Schmitt later informed Wheeler (1910) that this and a few other specimens were taken while he was sifting for beetles. There was no evidence as to their habits or any association with other ants. Wheeler (1905) found three nests at Bronxville, N. Y., that contained *H. americanus* and *L. curvispinosus*. One nest contained a single Harpagoxenus worker, another six, and the third eight workers and a deälated queen. In 1925 I found a nest (Sturtevant 1925) at Tarpaulin Cove, Naushon Island, Mass., that contained both *H. americanus* and *L. curvispinosus*. So far as I have been able to discover, these are the only recorded occasions on which H. *americanus* has been collected.

During the summer of 1926 I was fortunate in finding 16 nests of the species, at three different localities in New Jersey. Included in the new material are three kinds of individuals not previously described: males, winged queens, and individuals that look like workers but have rudimentary ocelli. I have also been able to make a few observations on the habits of the species. The present paper contains an account of this new material, with a discussion of the previous data and a comparison with the European species, *H. sublævis*, studied by Adlerz (1896) and Viehmeyer (1908, 1921).

Nest No.	Locality	Date	*Harpagoxenus* W	dead: winged ♀	♂ pupae	?	*Leptothorax curvispinosus* W pupae	Genus uncertain eggs	larvae	pupae
1	Naushon, Mass.	Au. 30'25	9	1	0	?	152	++	21	W
2	BelleMead, N.J.	Jl.8'26	16	0	0	W	20	?	+	W
3	Morristown,, N.J.	Jl.12'26	0	0	1	0	10	0	0	0
4	"	Jl.12'26	1	0	0	?	2 1♀,2♀,1♂	1	+	0
5	"	Jl.14'26	3	0	60	♂	30	++	+	0
6	"	Jl.14'26	3	0	14	♂	60 ±	5W	+	+
7	"	Jl.20'26	1	0	4	♂	0	0	+	0
8	"	Jl.20'26	2	0	0	0	10	0	+	0
9	"	Jl.30'26	30	1	3	0	100 ±	?	+	♀,♂
10	"	Se. 1'26	9	1	0	?	41	W	+	W
11	"	Se. 4'26	0	1	0	0	12	0	+	0
12	"	Se. 4'26	10	0	0	?	104	W	+	W
13	"	Se. 6'26	2	0	0	0	25	0	+	0
14	"	Se. 15'26	6	0	0	?	74	W	+	W
15	"	Se. 15'26	12	1	0	?	77	W	+	W
16	"	Se. 15'26	0	1	0	0	10	3W	3	0
17	"	Se. 15'26	4	0	0	?	43	W	+	W

Numbers 7 and 8 each contained a dead Harpagoxenus male.

Number 10 also contained eight workers of *Leptothorax longispinosus* Roger.

Numbers 1 and 8 taken in oak galls; 2, 3, 5, 6, 7, and 9 in old hickory nuts; 4, and 10 to 17 inclusive, in old acorns.

Table 1 gives the statistics for the 17 nests in which I have found Harpagoxenus. Numbers 3 to 9 were found in a small patch of woods near the village of New Vernon, numbers 10 to 17 about four miles away, near Morris Plains. In the first locality 50 pure nests of L. curvispinosus were taken in July and August; in the second 30 were found in September, and at Belle Mead eight pure nests were taken on July 8. I have collected 27 pure nests of L. curvispinosus at various other localities. This gives a frequency of infection of 17: 132=13%. The frequency can hardly be as high as this over most of the range of Harpagoxenus, for the species would then hardly be so rare in collections. It is probably local in distribution, though my success in finding it in four localities suggests that it may be commoner in galls and old nuts than in hollow stems, where the host has apparently been most often collected. I have taken only eight host colonies in hollow stems (of sumac and hickory); none of these were parasitized. I have also taken three pure nests of L. longispinosus (one in each of the regions near Morristown where Harpagoxenus was found and the third also near Morristown). None of these were parasitized.

At least two of the nests in Table 1 seem to represent fragments of colonies. Number 3 had no Harpagoxenus workers or deälated queen, but contained six winged queens and one male—the mother of which was therefore not present. Number 7 contained no Leptothorax at all. My observations agree with Wheeler's that Harpagoxenus is quite unable to care for itself, so this colony must have had Leptothorax workers. Perhaps they were out foraging when I collected the hickory nut. Similar observations have been made on pure nests of L. curvispinosus: e. g., over 20 nests have been found that contained no queen. Accordingly I was led to test nests from nuts lying within four or five feet of each other on the ground. In two cases (pure L. curvispinosus) the individuals from such nests showed no hostility whatever to each other, over a period of several days, though they promptly and vigorously attacked workers from nests taken in different localities. In several cases (including a few parasitized nests) such experiments led to mild fighting, which often did not occur for several minutes after the introduc-

tion of the strange ant, and was not continued long enough to seriously damage either contestant. Such attacks usually took the form of pulling legs or antennæ, without the usual accompaniment of doubling up the abdomen and rolling about the floor of the nest. These data suggest that a colony may break up into two or more daughter nests, and that these then gradually come to react toward each other as strangers. In accordance with this view is the fact that after the mating season[1] many of the pure nests have from two to twelve dealated queens; but the number of these seems then to decrease, until by the time winged forms are again produced practically no nest has more than one old queen. The data of Table 1 must then be studied with this evidence in mind, for it is clear that the individuals in one nest do not necessarily constitute an entire colony, whether we are dealing with pure or with parasitized colonies.

There are two chief problems concerning *H. americanus*: 1. How are pure colonies of Leptothorax first infected with Harpagoxenus—i. e., what is the method of colony formation? 2. Does an established Harpagoxenus colony recruit new auxiliaries, and, if so, by what method?

On July 31 I removed all but some irregular stumps of the wings of a queen Harpagoxenus (from nest number 9), and placed her in a pure *L. curvispinosus* nest that contained one deälated queen, about 70 workers and brood. The Harpagoxenus queen was attracted by the brood, but was quickly attacked by the workers. She at once became much excited, and moved so rapidly that the workers did not succeed in grasping her, except occasionally by the stumps of wings. She attacked them, but only by "nipping" at the antennæ or legs—never did she get the "bulldog grip" that is so characteristic of ants—even of Harpagoxenus workers. These nips were, however, effective, for within half an hour about ten workers had portions of one or both antennæ amputated. Usually the scape was cut in two. The remaining workers in the nest rapidly moved the brood as far as possible away from the invading queen—under

[1]Winged forms of *L. curvispinosus* were found in the nests from July 8 to July 30, with one belated male on August 10.

natural conditions they would presumably have left the nest entirely. The Leptothorax queen did not fare differently from the workers, and ultimately she was so maimed that she died. It seems probable that under natural conditions she too would have migrated. Battles occurred from time to time for several days, until most of the workers were more or less maimed. The Harpagoxenus queen showed interest in the brood only intermittently, but occasionally rested on it. New workers emerged in a few days, and on August 4 one of these callows was seen to feed the Harpagoxenus queen by regurgitation. The old workers still attacked her, however, and she grew gradually weaker, until she died on August 10.

If one may judge from this experiment, the fertilized queen of *H. americanus* enters a nest of pure Leptothorax and appropriates some of the brood. The workers and queen are attacked, and emigrate probably to find a new nest, taking much of the brood with them. The intruder is then adopted by the workers that emerge from the brood she has appropriated. It may be surmised that nests numbers 11 and 16 represent cases in which this has just happened. In each of these nests there was present a single deälated Harpagoxenus queen, with a few Leptothorax workers, but no Harpagoxenus workers or pupæ.

Nest number 10 constitutes the best evidence that *H. americanus* makes "slave raids,' for this nest contained, besides nine workers and a queen of Harpagoxenus, two different host species—41 L. curvispinosus and eight *L. longispinosus*. Both Adlerz and Viehmeyer have found nests of the European *H. sublævis* that contained two host species, and they have argued that these could be explained only on the assumption that *H. sublævis* makes raids. Wheeler (1905) found a mixed nest of *L. curvispinosus* and *L. longispinosus* (without a queen). and argued that if Harpagoxenus parasitized such a nest the result would be like that observed by Adlerz and Viehmeyer, but would not be due to raids. Viehmeyer (1921) has now actually witnessed the raids of *H. sublævis*, so there is no necessity for explaining away the "triple" nests of that species. It is to be noted that Wheeler's mixed nest was taken at the same place as his Harpagoxenus nests: it therefore seems to be most probable

that this mixed nest was in reality a portion of a parasitized colony (like number 10), that happened not to include any parasites.

The following experiment also suggests that raids are made by *H. americanus*. On August 2 an island was made by inverting a large pan and surrounding it by a moat. Three small piles of earth were placed on the island, and on each of these was placed a bit of sponge and a few bits of paper. Nest number 9 was placed on one pile of earth, and on each of the others was placed a pure nest of *L. curvispinosus*. The three colonies all became established, in the soil under their respective sponges. By August 10 there was very little loss by drowning in the moat, and relatively seldom were fights between foraging workers seen. Each Leptothorax nest had a single deälated queen, but these and the Harpagoxenus were practically never seen except when the nests were examined by lifting the covering bits of sponge or paper. The ants were fed chiefly on molasses and Drosophila larvæ, and all seemed to be thriving. But by August 21 one pure colony had disappeared and the other was very weak. On September 14 careful search revealed only the one flourishing parasitized colony. At this time there were observed to be some callow workers of Leptothorax present. While no raid was actually observed, it seems probable that both pure colonies were plundered by the Harpagoxenus (or perhaps by the auxiliaries) of the mixed colony, which did not change its position on the island during the course of the experiment.

Another reason for thinking that raids occur is that pupæ and callows of Leptothorax are so regularly present in the parasitized nests.

Winged queens are rare in *H. sublævis*. Adlerz failed to find any in Sweden, and in Germany Viehmeyer has found only a few. Their place is taken by worker-like forms that usually possess one or more ocelli. Adlerz has observed that these ergatoids mate, and has shown by dissection that they possess spermathecæ and well-developed ovaries. Such ergatoids have not been described in *H. americanus*, and the data show that true queens are common. Wheeler found one deälated queen, and six are recorded in this paper, together with nine winged

queens. These differ from the workers in the same ways as do the queens of most ant species. In addition, however, I have found a number of workers with rudimentary ocelli. Such specimens were present, for example, in nests 1 and 5. Usually the ocelli are represented in these specimens only by small chitinized humps, but sometimes small lenses are present. The number of these rudiments varies from one to three; the majority of workers do not show any trace of ocelli. Since 11 of the 17 nests found (and three of the four recorded by Emery and Wheeler) contained no deälated queens, one is led to suspect that H. americanus, like H. sublævis, has fertile worker-like females. This view is borne out by observations made on nest number 4. The only adult Harpagoxenus in this nest was a worker that had two small rudimentary ocelli. When collected, only one egg was found in the nest, but two days later four eggs were present. This observation is not conclusive, since it is not possible to be certain that the three eggs in question were not present all the time; and even if they were newly laid the Leptothorax workers may perhaps have produced them. I have dissected three workers (Harpagoxenus) from nest number 9. There were three ovarioles present in each ovary in all three specimens, and a sac arising from the anterior end of the common oviduct in every specimen is evidently the seminal receptacle. No spermatozoa were present, and no eggs were differentiated in the ovaries; but these specimens came from a nest that had an old queen, and they had been kept alive in the laboratory for three months, so the ovaries may not have been in normal condition. The evidence thus indicates that H. americanus has fertile worker-like females. It remains to be discovered whether these females infect new colonies by the method Viehmeyer supposes to occur in H. sublævis. This author surmises that such ergatoid forms take part in raids, and then remain in the raided nest and appropriate the remnants after their nest-mates have returned to the home nest.

It will be seen from table 1 that sexual forms of Leptothorax were present only in nest number 4, which contained two queen and one male pupæ. The two former emerged after the nest was brought into the laboratory. They were cared for by the

Leptothorax workers, and were not molested by the Harpagoxenus worker. They were not deälated, as is reported to occur for sexual forms (of both sexes) of the host species that emerge in nests containing *H. sublævis*. However, this nest was not long kept under observation.

My observations on the general behavior of the ants in the parasitized nests agree with those of Wheeler. The Harapagoxenus workers will eat if they happen to stumble onto a drop of food; but they do not forage, and are fed almost entirely by regurgitation from the Leptothorax workers. When the nest is disturbed they do not move the brood, and often are themselves transported by the much smaller Leptothorax workers. When a Leptothorax from a strange colony is put into the nest it is usually attacked by the auxiliaries, though in one case I have seen a Harpagoxenus take part in resisting such an intruder.

The male of H. americanus has not before been recorded. In the case of *H. sublævis* Adlerz did not at first distinguish the males from those of the host; but H. *americanus* males are strikingly different from those of *L. curvispinosus* in that they are shining black in color, and from those of *L. longispinosus* in that they have pale whitish yellow legs and antennæ. The eggs, larvæ, and newly formed worker pupæ I have not yet succeeded in distinguishing from those of Leptothorax; but worker pupæ nearly ready to emerge may be distinguished by their shoe ı epinotal spines.

Papers Cited.

Adlerz, G.

1896. Myrmekologiska studier. III. *Tomognathus sublævis* Mayr. Bihang, K. Svensk. Vet. Akad. Handl., vol. 21, pp. 3-76.

Emery, C.

1895. Beiträge zur Kenntniss der nordamerikanischen Ameisenfauna. Zool. Jahrb., Abt. Syst., vol. 8, pp. 257-360.

Sturtevant, A. H.

1925. Notes on the ant fauna of oak galls in the Woods Hole region. Psyche, vol. 32, pp. 313-314.

Viehmeyer, H.
1908. Zur Koloniegründung der parasitischen Ameisen. Biol. Centralbl., vol. 28, pp. 18-32.
1921. Die mitteleuropäischen Beobachtungen von Harpagoxenus. Biol. Zentralbl., vol. 41, pp. 269-278.
Wheeler, W. M.
1905. An interpretation of the slave-making instincts in ants. Bull. Amer. Mus. Nat. Hist., vol. 21, pp. 1-16.
1910. Ants: their structure, development and behavior. xxv-653 pp. New York.

AN INTERESTING BUTTERFLY CAPTURE.

By A. P. Morse,

Peabody Museum, Salem, Mass.

On August 6, 1926, while in southern New Brunswick, I took several specimens of a butterfly which looked unfamiliar, though it recalled both *Brenthis montinus* and *B. bellona*. Comparison with available examples of *B. chariclea* and *boisduvali* showed that it was most like the latter but differed in being considerably larger. As no example of that form was reported from nearer than Natashquan, Labrador, a specimen was sent, by permission, to Dr. F. H. Benjamin, curator of the Barnes collection, for determination. He tells me that it agrees perfectly with the type of *Brenthis chariclea grandis* of Barnes and McDunnough (Can. Ent., vol. 48, p. 223 (1916) from Hymers, Ont.

The original description emphasizes the deep purple color on the under side of the secondaries and the apex of the primaries. In my specimens the color is a deep golden brown, more or less suffused with purplish (lavender on the mesial pale band of the secondaries), a combination which, with the numerous dark and light spots of varied outline and arrangement, gives a very rich effect to the aspect of the lower surface of the wings.

This butterfly was captured in Charlotte County, N. B., only a few miles from the coast,—several hundred miles from Natashquan on the north shore of the St. Lawrence River, which is, I believe, the nearest point from which *boisduvali* has been recorded. This would seem good reason for believing that it will ultimately be found to be a resident locally of the mountainous portions of eastern Quebec, the colder sections of New Brunswick, especially near the coast, and also, perhaps, even of the eastern portion of Maine in the vicinity of Trescott and Cutler.

THE SLAVE-RAIDS OF *HARPAGOXENUS AMERICANUS.*

By W. S. Creighton,

Bussey Institution, Harvard University.

The observations here recorded were made at the American Museum of Natural History's Station for the Study of Insects at Tuxedo, N. Y. Through the courtesy of Mr. Frank Johnson of New York City the author was enabled to spend the summer of 1926 at the Station. To Mr. Johnson and to Dr. Frank E. Lutz, whose encouragement and support greatly facilitated this work, the writer wishes to express his sincere thanks. After the manuscript had been prepared it was learned that Dr.Sturtevant had made a number of observations about the same time on *Harpagoxenus* colonies found in New Jersey. I have had the opportunity of reading Dr. Sturtevant's manuscript and his results and mine amplify each other with very little repetition. In several cases observations have confirmed hypotheses in a remarkable manner, all the more striking in that neither of us knew of the work of the other. Dr. Wheeler has, therefore, suggested the simultaneous publication of the articles as they were originally prepared.

In 1893 Pergande found, near Washington, D. C., a mixed nest composed of *Leptothorax curvispinosus* (Fig. 1. B), and an unknown ant to which Mayr subsequently gave the name *Tomognathus americanus* (Fig. 1, A). Later the generic name was changed by Forel to *Harpagoxenus,* the specific name remaining unaltered. Besides the type specimens of *H. americanus* Mayr had a few others accidentally taken by Schmitt while collecting beetles at Beatty, Pa. During the next twelve years there are no further records of this ant until, in 1905, Dr. Wheeler discovered, near Bronxville, N. Y., three small mixed colonies of *H. americanus* and *L. curvispinosus* nesting in hollow elder twigs. The next observation on this rare insect came twenty years later when Sturtevant, during the summer of 1925, found on Naushon Island (Woods Hole) a mixed *Harpagoxenus—L. curvispinosus* colony inhabiting an oak gall.

Fig. 1. A, worker of *Harpagoxenus americanus*; B, worker of *Leptothorax curvispinosus*, after Wheeler.

During the past summer I found a number of nests of *H. americanus* near Tuxedo, N. Y., and was fortunate enough to see these ants engaged in slave raids. In all but one nest the slave ant was *L. longispinosus*. The remaining colony contained slaves of both *L. longispinosus* and *L. curvispinosus*, a condition parallel to that described for the European *H. sublævis*, which enslaves both *L. acervorum* and *muscorum*. Dr. Wheeler postulated that such colonies should occur, since he found a queenless *longispinosus-curvispinosus* colony in the vicinity of the *Harpagoxenus* nests. However, since he did not think *H. americanus* a dulotic ant, he considered the colony as one which needed only the advent of a deälated *Harpagoxenus* queen to form a mixed colony containing two species of slaves. For reasons to be subsequently given I would consider Dr. Wheeler's mixed *Leptothorax* colony as a remnant, originally formed by dulosis, from which the *Harpagoxenus* had migrated or been killed off while raiding.

Before taking up the discussion of *H. americanus* it seems advisable to briefly outline the ethology of the European species. *H. sublævis* has been known since 1848, and since that time a number of observations have been made on its habits. It appears to have a wider distribution than its American cogener, for it has

been taken in Finland (Nylander), Denmark (Meinert), Sweden (Stolpe and Adlerz), Saxony, West Prussia, Bohemia (Viehmeyer) Kärnten, Austria (Wolf), and the Swiss Engadine (Emelius). In this last location it occurs at an altitude of 1600-1700 meters. The pioneer observer of *sublævis* was Adlerz, who in 1896 conducted numerous experiments on these insects in artificial nests, supplemented by observations in the field. He found that in the mixed colonies the slave ant was usually *L. acervorum*, occasionally *L. muscorum* and rarely *L. tuberum*. Normal deälated *Harpagoxenus* queens were never present, their place in the colony being taken by the ergatoid female, a wingless worker-like insect possessing ocelli and a *receptaculum seminis*. Alderz further showed that the *sublævis* workers, if forced to do so through the absence of slaves, are able to feed themselves but do not care for the brood. This is normally tended by the slaves who feed the larvæ with regurgitated material and fragments of insects. This last observation was later confirmed by Viehmeyer, who amplified the work of Adlerz by discovering, near Dresden in 1906, the true winged queens of *sublævis* which Adlerz had supposed did not exist. Viehmeyer's observations '08) show that the actions of a *sublævis* female in founding a colony closely parallel those of *sanguinea* queens. After the entrance of the parasitic female into the *Leptothorax* nest the workers attack her, but are eventually killed or driven away by the larger insect who then takes possession of the nest and brood. Adlerz had previously observed similar actions of the ergatoid females and had concluded that *sublævis* customarily obtains its slaves in this manner. Such dispossession was thought to be fundamentally different from the raids of the amazons and sanguinary ants, who, after the pillage of the strange nest, return to their own with the plundered brood. Both Adlerz and Viehmeyer saw the "raids" of *Harpagoxenus*, if by this term we may translate the *eröfringstag* of the former writer and the *Raubzug* of the latter. Unfortunately both these investigators interrupted the proceedings by disturbing the nests, with the result that it is impossible to tell from their observations whether they witnessed a true raid or the dispossession of *Leptothorax* nests by the *Harpagoxenus*. Indeed, Adlerz considered

that this last was what he had seen, but Viehmeyer seems to have interpreted the two forays which he discovered as true raids. Moreover each found mixed colonies which contained slaves of both *L. acervorum* and *L. muscorum*. Since the possibility that such colonies could have been formed by dispossession is very remote, these investigators concluded that *H. sublævis* must make dulotic raids. It is gratifying to be able to supplement their observations with others on the dulosis of *H. americanus*.

The slave raids of *Harpagoxenus* show none of the organization and spirit so characteristic of those of *Polyergus*. They fall far short even of the lesser degree of cooperation exhibited by *F. sanguinea*. Nevertheless they are of great interest, since they appear to be the last manifestation of a vanishing character. They show the decay of dulosis and foreshadow a state of abject parasitism. During the progress of a raid the *Harpagoxenus* workers and their slaves cluster about the entrance of their nest in a manner suggestive of *Polyergus*, but with this the similarity ends. There is no rapidly moving phalanx of raiders, no concentration about the entrance of the raided nest, no frantic activity to enlarge the entrance. The *Harpagoxenus* leave their nest singly and amble awkwardly and uncertainly to the nest of their victims. Only once did I see more than one *Harpagoxenus* leave the nest at the same time. On one occasion a column of three departed for the *Leptothorax* nest. However, this column broke up almost at once and was, I believe, purely fortuitous. On arriving at the *Leptothorax* next the *Harpagoxenus* wastes no time in preliminaries but enters at once. Having secured a larva or pupa it emerges as quietly as it entered and returns with its burden to its own nest. Quite often they lose their way and I have seen a number of them captured by small spiders while raiding. The action of *Harpagoxenus* after it enters the raided nest could not, of course, be followed in the field. However, observation of ants in artificial nests show that the brood is obtained by force and not by stealth, although indeed, the action of the *Leptothorax* during a raid furnishes ample evidence that this is the case.

The nest which yielded most of the observations on the

slave-raids was ideally situated for such work. It was in a crevice in one of the many out-jutting ledges of rock which studded a slope above a small pond. Jammed into the crevice was a small flake of stone which formed a little shelf on the perpendicular face of the ledge, and between this flake and the solid rock the nest was constructed. The entrance had been enclosed by a carton of lichens, perforated in the center by an almost circular aperture. Eleven feet away under the bark of a small log which rested on the ledge was the nest which the raiders visited. Between the two nests the ledge was bare except for large black lichens and occasional leaves and fragments of bark. The progress of the raiders could therefore be followed with the greatest ease, an important consideration when dealing with small, slowly moving insects.

The first raid was observed on August 4th. Arriving at the nest at 3:00 P. M. I noticed a crowd of *Leptothorax* and *Harpagoxenus* about the entrance. At 3:02 a *Harpagoxenus* arrived with a pupa. Another at 3:04. In both cases the *longispinosus* workers crowded about the returned raider apparently attempting to relieve it of its burden. A third pupa was brought in at 3:08 and carried directly into the next by the *Harpagoxenus*, which turned and backed into the entrance pulling the pupa in after it. At 3:25 a *Harpagoxenus* arrived with a callow. Another with a pupa at 3:26. In each case the raider entered the nest with its burden in the manner just described. During transportation the pupæ are held in such a way that they project forward and upward in front of the head of the raider.

The log in which the raided nest was located was small and badly decayed. The bark had loosened with the decomposition of the underlying wood and, as was later determined, just under the bark in a roughly oval excavation was the raided nest. To this the *Harpagoxenus* gained access through a rupture in the bark several inches away. The actions of the raiders on arriving at the log were somewhat disconcerting. They entered as nonchalantly, if I may be pardoned an anthropomorphic term, as though it had been their own nest. However any doubts as to the nature of their visit were quickly dispelled by the action of the *Leptothorax*. About ten inches from the point

where the raiders entered a group of *longispinosus*, with part of the brood, had collected on the surface of the bark. They were huddled above the brood or moving uneasily nearby. In the group were several males. The importance of this observation cannot be minimized. It is proof positive that the actions of the *Harpagoxenus* were dulotic and not migrational. It removes the possibility that the nest in the log was a remnant of the mixed nest in process of transportation to a new site. It shows that the *Leptothorax* were aware of the presence of the raiders and, being unable to prevent the pillage of their nest, had resorted to flight to save the brood. Coupled with the actions of the raiders it establishes their dulosis in a manner which seems incontrovertible.

Additional evidence of a less conclusive nature was obtained by an examination of the raided nest. This was made on August 9th, after a heavy thunderstorm had put an end to the raids. The *Leptothorax* colony was in no respect a remnant. No *Harpagoxenus* were present. There were about forty *longispinosus* workers, a brood consisting largely of larvæ, and a dozen virgin queens. The old queen I could not find. It is entirely likely that she had perished during the raid, but in any case the presence of the virgin queens is a guarantee that the colony had been queenless for only a short time, if at all. Alderz's observation that sexual forms of the slaves are sometimes present in mixed colonies of *H. sublævis* invalidates what might be otherwise considered additional conclusive evidence of the individuality of the raided nest. However the character of the *Leptothorax* colony is at least not contradictory to the conclusion reached above.

I shall cite one further field observation before taking up those made on ants in artificial nets. It may perhaps serve to impress the reader with the degenerate nature of the dulosis of *Harpagoxenus*. On August 5th I arrived at the mixed colony at 2:00 P. M. The entire ledge was in the shade and no ants were outside the nest, although I could see the head of one in the entrance. During the next three quarters of an hour a few *Leptothorax* left the nest and wandered about on the ledge nearby. During this time also the shadow had shifted, so that when at

2:45 the first *Harpagoxenus* emerged the ledge was in the bright sunlight. After a short period of aimless wandering the *Harpagoxenus* started in the direction of the raided nest. Its progress was slow and uncertain, and on several occasions it became lost, to judge from its haphazard movements. It entered the *Leptothorax* nest at 3:14, having required twenty-nine minutes to cover 3.35 meters. Five minutes later it emerged with a callow and began to retrace its steps. In so doing it passed close to a *longispinosus* worker. The later drew back at its approach and then stood perfectly quiet until the raider had passed, an action which I subsequently observed many times in the artificial nests. Despite the added burden the *Harpagoxenus* completed the return trip in twenty-two minutes, entering its nest at 3:42. Neglecting the preliminary movements after its emergence from its nest, and deducting the five minutes spent in the raided nest, the entire trip of about 6.7 meters had been completed by the *Harpagoxenus* in fifty minutes. This gives it an average speed of 13.5 cm. per minute. Compare this with Dr. Wheeler's observations ('10) on the speed of *Polyergus* when raiding, viz: 1.3 meters per minute. It is true that *Harpagoxenus* is a small ant, scarcely a third the length of *Polyergus*, yet its smaller size will hardly account for its discrepancy in speed. I recently had the opportunity to study the rate of movement of *Iridomyrmex humilis*, a smaller ant than *Harpagoxenus*, and found that under optimum conditions it moved at the rate of approximately 2.75 meters per minute. Size, then, has little to do with the activity of an ant. If, as seems altogether likely, we can assume the correctness of Dr. Wheeler's postulate, ('07) that the ancestors of dulotic ants were active, predatory insects; if from this condition dulosis arose as a refinement of active predatism; then we must regard an ant which, though a raider, is slow and clumsy of movement as one in which the dulotic instincts are nearing extinction.

We now take up a series of observations upon ants in artificial nests, which are of interest in that they suggest what takes place when the raiders first enter the nest of their victims. On August 20th, while collecting in a damp wood, Mr. Brandt Steel called my attention to what I at first took to be a mixed colony

of *Harpagoxenus* and *L. curvispinosus*.The nest was situated in a hollow twig that rested on a moss-covered rock. The open end of the twig had been plugged with a beautiful lichen carton with the customary circular aperture in its center. On the outside of the twig a group of the yellow *curvispinosus* clustered about a *Harpagoxenus* worker, while on the rock immediately below was a similar group. The entire colony was easily collected, placed in a handkerchief, and subsequently transferred to a plaster observation nest. On splitting the twig two more *Harpagoxenus* workers were found. Once the nest was installed in the obsertion nest it became apparent that I had misjudged the situation. The only queen present was that of the *Leptothorax*. Moreover under the binocular I could see the curvispinosus workers clinging with locked mandibles to the legs and antennæ of the *Harpagoxenus*. Here was no mixed colony but a number of raiders, fiercely resisted by the *curvispinosus*. That the latter had suffered in spite of their superior numbers was evident from their missing legs and antennæ. While I was watching, one of the *curvispinosus* maneuvering for a grip on the antenna of the *Harpagoxenus* had both its own antennæ bitten off when it came within reach of the intruder's jaws. Three of the four *Harpagoxenus* workers were thus surrounded. The fourth had found a shelter under a piece of leaf mould. Here it remained coming out only to drive away any *curvispinosus* that approached its refuge. By next day the *curvispinosus* had established themselves in a small cavity in the plaster at one end of the nest. The brood had been carried inside and the entrance partially blocked by vegetable detritus. During the night two of the *Harpagoxenus* workers had succombed to the attacks of the *curvispinosus* and a third seemed badly crippled. The remaining *Harpagoxenus*, in all probability the one who had stayed under the leaf mould, was now surrounded by three *curvispinosus* workers which had fastened their mandibles on its legs and antenna. It made no efforts to extricate itself during the entire day but must have succeeded in doing so during the following night, for on the morning of the 2nd, it was wandering about the nest apparently uninjured. At this time there were nine dead *curvispinosus* workers in the nest.

At 1:37 P. M. the *Harpagoxenus* entered the little cavity in which the *Leptothorax* had placed their brood. Thirty seconds later the *curvispinosus* queen came hastily out and ran to the opposite end of the nest. After another thirty seconds a *curvispinosus* worker emerged with a pupa. This worker was followed by the *Harpagoxenus* for a short distance, but the latter quickly returned to the cavity. One minute later it appeared in the entrance to the cavity with a *Leptothorax* worker in its mandibles. This it dropped outside the cavity and immediately reentered. A general distrubance now pervaded the *Leptothorax*. An exodus of those in the cavity, many of them carrying pupæ, was followed by a spread of the excitement to the workers in the nest, who ran about in a confused and terrified manner. A few bold individuals remained at the entrance of the cavity and two ventured inside long enough for each to recover a pupa. A third worker who attempted to enter was apparently seized by the *Harpagoxenus*, for it disappeared into the cavity with startling suddenness and did not come out again.

At 2:00 P. M. the *Harpagoxenus* began a series of manouvers which can best be described as "reconnoitering.". At first it thrust only its head out of the entrance of the cavity and waved its antennæ about. At such times any *curvispinosus* near the cavity rushed away as though in terror. After about forty minutes of this behavior, it began making short sorties from the cavity. At first it hardly more than emerged, returning at once, but after twenty minutes it began to extend its reconnoiters. Twice during these sorties the *Harpagoxenus* attacked and injured a *curvispinosus* worker. In both cases this was done in a deliberate and spiritless manner. Most of the *curvispinosus* workers who chanced to encounter the intruder ran from it and were not attacked. When it left the cavity at 3:40 a change seemed to come over the *Harpagoxenus*. It no longer lumbered about the nest in its customary manner. Its movements were quick and active. During the next thirty-two minutes the *Harpagoxenus* attacked and injured eight *curvispinosus* workers with a ruthlessness and a "mordlust" that would have done credit to *Polyergus*. The victims were bitten in the thorax and abdomen and left in a dying condition on the floor of the nest. Twice

during the absence of the *Harpagoxenus* from the cavity a *curvispinosus* entered and secured a part of the brood, and once the raider returned in time to drive away two others who were about to enter. During the foregoing period most of the *Leptothorax* had collected in two groups on the floor of the nest, the larger of which contained the queen and the majority of the brood carried out of the cavity. The *Harpagoxenus* now began to pass close to the *curvispinosus*. At 4:19 it approached the smaller group and attacking the workers, drove them away from the brood. This it examined with great care, touching the larvæ and pupæ with its antennæ. Two *curvispinosus* workers which attacked it in a half-hearted manner were quickly driven away. To my surprise it left the brood unmolested and turned to the larger group of *Leptothorax* which was now in great confusion. Some of them the *Harpagoxenus* drove away, attacking so vigorously two workers burdened with pupæ, that the pupæ were abandoned and their bearers put to flight. It then attacked a *curvispinosus* callow and soon afterwards bit off the antennæ of a worker. At 4:28 it returned to the cavity having taken no further notice of the brood. At this point the observations were interrupted for an hour and a half. When I returned the *Harpagoxenus* had left the cavity and had been seized by three *curvispinosus* workers. All of its former spirit and activity was gone, nor did it ever again manifest these characteristics. It lay supine and unresisting on the floor of the nest, its antagonists attached to its legs with locked mandibles. This was the condition at 10:00 P. M. However by next day it had freed itself and, to judge from the diminished brood of the *Leptothorax*, had carried a number of larvæ and pupæ into the cavity. At 11:17 A. M. it emerged, secured a pupa and returned with it to the cavity. The disorganization of the *Leptothorax* was complete. Twenty dead or dying workers were scattered about the nest. The queen lay on one side apparently dead. The remaining workers moved aimlessly about, a few carrying pupæ or larvæ. They no longer resisted or ran from the *Harpagoxenus* but stood perfectly quiet when it approached, and even allowed it to touch them with its antennæ. by the following day the *Harpagoxenus* had obtained practically all of the *curvvspinosus* brood. Only five larvæ and pupæ remain-

ed outside the cavity. During the next night the *curvispinosus* recovered a part of their brood but this was again taken by the *Harpagoxenus*. This see-saw possession of the brood continued until September 3rd., when it was ended by the death of the *Harpagoxenus*. At this time there were eight *curvispinosus* workers still alive. They immediately occupied the cavity and resumed the care of the brood.

Any interpretation of the facts just described may be criticized on the grounds that the ants were captive insects placed in artificial surroundings. I am convinced that their actions may be explained on just such a basis, viz: that they were captives, unable to leave the artificial nest. There can be little doubt that the actions of the *Harpagoxenus* constitute a "dispossession" of the *Leptothorax* of their nest and brood. Nevertheless this cannot be regarded as the founding of a mixed colony. With this in mind I examined the four *Harpagoxenus* individuals with the greatest care and can positively state that not one of them was an ergatoid female, if one may judge by the absence of ocelli or a female type of gaster. Under such circumstances the most plausible explanation is that of an interrupted raid. A condition making the return of the raiders to their own nest impossible, in this case confinement in the artificial nest, is, I believe, the reason for such occurrences. I have already given reasons for believing that the vestigial dulosis of *Harpagoxenus* makes its raids, even under the most favorable circumstances, very precarious. The surroundings of the nest from which the raids described above took place were as nearly ideal as could have been wished. The distance between the two nests was compararatively short. The smooth rock surface with its scattered lichens offered a minimum of obstructions and a substrate which facilitated the progress of the raiders. Yet even here the *Harpagoxenus* had difficulty in finding their way to and from the raided nest and frequently lost their way. Under the less favorable conditions of terrain which usually surrounds the colonies the chances for a successful raid would be greatly lessened. The initial entry into the raided nest is, as the above observations show, a difficult matter requiring much time. During the interval, perhaps several days, from the advent of the first intruder

to the successful defeat of the defenders of the nest, there is ample time for altered external conditions. A heavy thunder shower might completely change the character of the ground between the two nests, efface any scent trails present, and render the return of the raider to its own nest extremely difficult or impossible. Under such circumstances there would result a mixed nest containing no queen but *Harpagoxenus* and *Leptothorax* workers. I found one such nest during the past summer and two of the nests which Dr. Wheeler discovered near Bronxville were of this character. It seems likely that the development of the ergatoid females in the European *sublævis* may have come about as a response to frequently interrupted raids. An insect of this type, able to participate in a raid and equally able to function as a queen, should a return to its own nest become impossible, is at least a logical outcome of such conditions.

An enumeration of all the mixed colonies found during the past summer will be given here, together with such observations as have not been already recorded.

No. 1, found Aug. 4th, is the colony from which the raids took place. Since it was never distrubed an accurate count of the number of ants present cannot be given. It was, however, a comparatively large colony and I should estimate that it contained at least a dozen *Harpagoxenus* workers and ten or twelve times that number of *L. longispinosus* slaves.

No. 2, discovered on Aug. 6th, was the largest colony of any that were seen. It was under a stone on one of the ledges about thirty-five meters to the west of No. 1. Since the nest was almost entirely surrounded by an area of perfectly bare rock it was an easy matter to collect the whole colony. Stragglers that escaped the initial transfer were picked up with a camels-hair brush and placed in the artificial nest. I am certain that not more than half a dozen ants escaped. The colony contained a normal *Harpagoxenus* queen with vestiges of wings, 17 *Harpgagoxenus* workers, 30 *L. curvispinosus* workers, 206 *L. longispinosus* workers 2 *longispinosus* males and considerable brood, most of which subsequently proved to be *Leptothorax*. The *Harpagoxenus* workers were very inactive, rousing themselves only to solicit

food from their slaves. The *Leptothorax* workers spent much time diligently licking their lethargic masters.

No. 3 can hardly be considered a mixed colony, for as such I designate the *L. curvispinosus* nest attacked by the four *Harpagoxenus* raiders. It was found Aug. 20th, and is included here for the sake of clarity.

No. 4 was taken on Aug. 24th. It was located under a small flake of stone on the top of a boulder about eight meters from the spot where No. 3 was discovered. It contained a normal, deälated *Harpagoxenus* queen, 11 *Harpagoxenus* workers, 113 *L. longispinosus* workers and a fair amount of brood. I feel sure that the raiders found in No. 3 came from this nest, but experiments to prove this, while not invalidating the opinion, gave inconclusive results. Six *Harpagoxenus* males were produced in this colony after its transfer to an artificial nest. These are so different from the insect figured by Alderz ('96) as the male of *H. sublævis* that, were it not for his statement that he observed *Harpagoxenus* males in copulation with ergatoid females, it would seem likely that he had described aberrant males of *Leptothorax*. A figure of a *Harpagoxenus* male, together with a description is given at the end of this paper.

No. 5 was found on Aug. 30th., in dry, fairly open woods. The colony was under a flake of stone on the top of a boulder. Not wishing to disturb it I removed the covering stone only long enough to make certain of the presence of the *Harpagoxenus* queen, and to count the *Harpagoxenus* workers, of which there were twelve. I did not atetmpt to count the *longispinosus* slaves but would estimate that there were about a hundred.

No. 6, a small queenless colony was also found on Aug. 30th., about fifteen meters from No. 5. It consisted of two *Harpagoxenus* workers, ten *L. longispinosus* workers and a small brood of a dozen or more larvæ. When the stone covering the nest was removed both the *Harpagoxenus* and the *longispinosus* seized the larvæ and attempted to move them out of danger. I am of the opinion that this nest represents a *L. longispinosus* colony "dispossessed" by raiders from No. 5, who for some reason were unable to return to their own nest.

No. 7 was found on Sept. 3rd., about seventy-five meters

to the west of No. 5. It was plainly an incipient colony containing a normal deälated *Harpagoxenus* queen, one *Harpagoxenus* worker and thirty-five *longispinosus* slaves and a large brood composed entirely of larvæ. The queen was subsequently found to lack the last pair of legs, only the stumps of these remaining.

This mutilated condition was also true of a deälated *Harpagoxenus* queen which was taken on Aug. 3rd. This insect, which was crawling over a stone when discovered, lacked the left antenna and one leg on the left side. It seems likely that it had been repulsed in an attempt to enter a nest of *Leptothorax*, since there were two fairly large *longispinosus* colonies about three meters from the stone where the *Harpagoxenus* queen was found. A most careful search failed to reveal any mixed colony in that vicinity.

As may be seen from the foregoing descriptions *H. americanus* presents one striking contrast to the European species. Normal winged queens are the general rule with *americanus* instead of the ergatoid females which usually take their place in *sublævis*. The ergatoid form seems to be as rare in the colonies of *americanus* as are the winged queens in those of *sublævis*. I have never seen an ergatoid female in any of the colonies thus far observed.

While much remains to be done it is now possible to sketch the ethology of *H. americanus*; a hasty sketch to be sure with many missing features hypothetically supplied, but at least a beginning. In this picture we see the fertilized *Harpagoxenus* queen entering a *Leptothorax* nest by force. Having driven away or killed the original owners of the brood she appropriates this, tends it and is in turn tended by the resulting *Leptothorax* workers, until in time there arises a mixed colony. When the colony is well established the dulotic instinct manifests itself in the *Harpagoxenus* workers. These gain entrance to some *Leptothorax* nest after a long struggle in which their greater hardiness and superior size finally enables them to kill or intimidate the *Leptothorax* workers. If the external conditions are favorable the raid is carried to a successful conclusion and the brood of the pillaged nest is carried back to the mixed colony. If the

return of the raiders is rendered impossible then a fragmentary mixed *Harpagoxenus-Leptothorax* colony results.

The phylogeny of *Harpagoxenus* has been a matter of considerable speculation. The development of its raiding habits, a point formerly much disputed, is now agreed as paralleling that of *Polyergus*. Viehmeyer ('21) eventually concluded that his hypothesis of the lestobiotic derivation of the raids of this ant was untenable and accepted the above explanation. On the other hand, there has never been any doubt of the close morphological affinities of *Harpagoxenus* to *Leptothorax*. *L. acervorum* (subgenus *Mychothorax*) is considered as closely related to, or identical with the ancestral form. It is generally believed that the parasitic ants (intraspecific parasitoids) have been devired from those species which they parasitize. (Wheeler '19). Occasionally when the parasitic relation has been of long standing the original host may have become rare or extinct and have been replaced by another closely related to it. The relation of *Harpagoxenus* to its slaves clearly illustrates both these points. The resemblance between the European *H. sublævis* and *L. acervorum*, its usual host, is close. On the other hand *H. americanus* parasitizes either *L. longispinosus* or *curvispinosus*, neither of which it particularly resembles. This is exactly what we should expect from the distribution of the host species. *L. acervorum*, a dominant ant in the European palæartic fauna, is rare in North America. The dominant neartic forms in this country are *L. longispinosus* and *L. curvispinosus*. It would be expected that the American *Harpagoxenus* would have adopted these forms in place of the rare *acervorum*.

In the study of phylogenetic relationships the males play an important part because of their morphological stability. Since the males of *H. americanus* have been hitherto unknown it seems advisable to devote a brief survey to the phylogeny of this ant. Through the kindness of Dr. Wheeler I have been enabled to examine material in his collection, and on this the following comparisons were made. We should expect morphological similarities to be most manifest in the males of the two genera and least apparent in the workers. Nevertheless even the latter exhibit a number of significant features in common. The work-

ers of *L. acervorum* and *Harpagoxenus* both have eleven-jointed antennæ. The importance of this lies in the fact that the subgenus *Mychthorax*, to which *acervorum* belongs, is the only one of the holarctic subgenera of *Leptothorax* which exhibits this characteristic. Furthermore, in both *Mychothorax* and *Harpagoxenus* there is an impressed mesoepinotal suture. Since the combination of these two characters is the criterion by which *Mychothorax* is separated from all the other subgenera in the group, their occurrence in *Harpagoxenus* leaves little room for doubt as to the close relation of the two genera.

The similarity between the males of *H. sublævis* and *L. acervorum* was close enough to confuse even such a careful observer as Adlerz. (96). Unfortunately it has not been possible to examine the male of *sublævis* but a comparison of Adlerz's figure with the male of *acervorum* showed differences which are rather surprising in the light of that author's statement. In *H. americanus* there are even greater differences. Nevertheless these insects show a sufficient number of similar characters to justify the view that *Harpagoxenus* has been derived from *Mychothorax*. The males of both genera have twelve-jointed antennæ and in *H. sublævis* the shape of the joints is almost identical with that of *L. acervorum*. Curiously enough except for the number of joints, the antenna of *H. americanus* resembles that of *L. longispinosus* rather than *acervorum*. The mandibles of *H. sublævis* are similar to those of *L. acervorum* in that they are toothless and so short that they do not meet. The mandibles of *H. americanus* are longer, toothed and mucronate at the tip. In regard to petiolar structure *H. americanus* more closely approaches *L. acervorum* than does *sublævis*. Neither of the former possess the ventral tooth which arms the second node of the petiole in *H. sublævis*. It is interesting to note that the second petiolar node in *L. acervorum* is somewhat expanded laterally, since the squamiform second node is a marked characteristic of *Harpagoxenus*. Allowing for the minor variations which occur within the species, the anterior wing venation in the males of the two genera is practically identical. The hind wings of *H. americanus* are veinless, but those of *sublævis* and *acervorum* are correspondingly veined.

From the foregoing consideration it is clear that *H. sublævis* shows closer affinities to *L. acervorum* than does *H. americanus*. This may be correlated with the habits of the two slave-makers. *Sublævis* has apparently always lived with the host from which it was derived and has therefore changed only slightly. On the other hand, *americanus*, adopting new hosts, has diverged to a greater extent from the ancestral type.

In conclusion is given a description of the male of *H. americanus* (Fig. 2.)

Fig. 2. A, male of *Harpagoxenus americanus*; B, head of same.

Length: 2.7 mm.

Color: head, thorax and abdomen brownish black; antennæ and legs very pale, almost transparent in fresh specimens.

Head rugulose with numerous erect hairs. Thorax feebly rugulose, somewhat glabrous, and with fewer hairs. Abdomen glabrous with sparse erect hairs. Antennæ 12-jointed. Funiculus without a distinct club but the joints gradually increasing in diameter towards the tip. First funicular joint pyriform, much broader than those immediately succeeding it. Second and third funicular joints cylindrical and distinctly shorter than the adjacent joints. The following joints sub-oval and gradually increasing in length towards the tip. Scape one quarter the length of the funiculus. Scape and funiculus clothed with a short erect pubescence. Antennal scrobes much shallower than in female and worker, but distinct. Mandibles long and narrow, feebly toothed and sharply mucronate at the tip. Neck long and flattened dorso-ventrally.

Anterior face of mesonotum abruptly projecting above pronotum. Mayrian furrows strongly impressed at the promesonotal suture, but becoming feeble at their point of confluence. Fore wings with a short open radial cell. Hind wings veinless except for faint impressions at the base of the wing. Epinotum unarmed. Second node of petiole without ventral tooth, squamiform, broader and less constricted behind than in worker. Petiolar hairs sparse.

Literature.

Adlerz, Gottfrid

1896. Myrmecologiska Studier. III. *Tomognathus sublævis*. Bihang Till K. Svenska Vet. Akad. Handlingar. Band 21, Aft. IV No. 4, pp. 3-76.

Sturtevant, A. H.

1925. Notes on the Ant Fauna of Oak Galls in the Woods Hole. Psyche vol. 32, pp. 313-314.

Viehmeyer, H.

1906. Beiträge zur Ameisenfauna des Königreiches Sachsen. Abhandl. naturwiss. Gesell. Isis, Dresden, pp. 55-69.

1908. Zur Koloniegrundung der parasitischen Ameisen. Biol. Centralbl., vol. 8, pp. 18-32.

1921. Die mitteleuropäischen Beobachtungen von Harpagoxenus. Biol. Centralbl., vol. 41, pp. 269-278.

Wheeler, W. M.

1907. The Origin of Slavery among Ants. Pop. Sci. Month., vol. 71, pp. 550-559.

1910. Ants, Their Structure, Development and Behavior. Columbia University Press, 1910.

1919. The Parasitic Aculeata, a Study in Evolution. Proc. American Phil. Soc., vol. 58, pp. 1-40.

NOTES ON A COLLECTION OF AMBER ANTS.[1]

By F. M. Carpenter.

In a collection of parasitic hymenoptera from the Baltic Amber, now at the Bussey Institution, a number of other insects were accidently included, among which were 89 ants. This small ant collection is peculiar in that it contains a higher percentage of males than has been the case with former material. In such collections the workers have far excelled the sexual forms in respect to the number of individuals present, but in the collection before me the males are almost twice as abundant as the workers. The species represented in this material are listed below, together with a few notes on their occurrence, and the numbers identifying the specimens in the two collections (Museum of the University of Könisberg and the Fritsch collection) to which the fossils belong. The species present, except one, were described by Mayr[2] in his paper, "Die Ameisen des baltischen Bersteins", and by Professor W. M. Wheeler[3] in "The Ants of the Baltic Amber."

Myrmicinae

Erebomyrma antiqua Mayr: Two males in the Univ. Königsberg collection, both without numbers. These two specimens increase the number of observed males of the species to seven.

Stenamma berendt Mayr : One male, Univ. Königsberg (xxB979). This is the third specimen of this species that has been found. It is curious that the species should be present in so small a collection as this, since only two other individuals have been seen in the 11678 amber ants that have previously been studied.

[1]Contribution from the Entomological Laboratory of the Bussy Institution, Harvard University, No. 274.

[2]Beiträge zur Naturkunde Preussens, hereausgegeben v. d. physik.—ök Ges. zu Königsbreg, 1, 1868.

[3]Sonderabdruck aus den Schriften der Phpsikalisch—ök. Ges. zu Königsberg, i. Pr., LV. 1914.

Nothomyrmica rubis Mayr: One worker in the Univ. Königsberg (xxB859).

Leptothorax gracilis Mayr: One worker and one male, both in the collection of the University of Königsberg, and without numbers.

Dolichoderinae

Dolichoderus balticus Mayr: One specimen, Univ. Königsberg collection (11017/364), the sixth individual to be found.

Dolichoderus tertiarius Mayr: One male in the Univ. Königsberg collection. (137060/437).

Iridomyrmex geinitizi Mayr: Three males and three workers in the Univ. Königsberg collection (9561/289, 7501/239, xxB768, B18282, and two without numbers); one worker in the Fritsch collection (207).

Iridomyrmex gœpperti Mayr: Eight workers and one male in the Univ. Königsberg collection (B19423, xxB1771, 7444/182, and six without numbers); one worker in the Fritsch collection (186).

Formicinae.

Prenolepis henschei Mayr: One worker and one male, Univ. Königsberg collection (xxB104, 7479/217).

Prenolepis pygmæa Mayr: Nine males in the Univ. Königsberg collection (9757/303, 4195/76, etc.); ten males in the Fritsch collection (163, 62, 96, 186, etc.).

Lasius schiefferdeckeri Mayr: Two males in the Fritsch collection (246, 229).

Lasius punctulatus Mayr: One female in the Fritsch collection. (230).

Formica flori Mayr: One worker and two males in the Univ. Königsberg collection (xxB908, and two without numbers); four males in the Fritsch collection (241, 216, 197, 138).

The remaining specimens are too poorly preserved to permit satisfactory determination, and with the exception of one individual none of these presents any striking characteristics. The specimen referred to is a male ponerine (Fritsch collection, number 4) and differs from other known males of the subfamily by having a twelve-jointed antenna; a low, rounded petiole with an anteroventral keel; and forewings with the veins crowded anteriorly and basally. Professor Wheeler kindly examined this specimen, but did not regocnize it as belonging to any existing genus. However, the present knowledge of extant male ponerines is too incomplete to allow determination of the affinities of this species, until the worker has been found.

DIPTEROLOGICAL NOTES

By Charles W. Johnson

Boston Society of Natural History

The Infestation of Bluebird Nests by Protocalliphora: From Mr. A. W. Higgins of Rock, Mass., I received (July 23, 1926) an abandoned bluebird's nest containing 154 larvæ and pupæ of Protocalliphora. The nest was packed in a tight tin box and as the weather was exceedingly warm it heated in transit and the larvæ were dead. Between July 30 and August 3, 24 flies emerged, all representing *P. splendida* form *sialia* Shannon and Dobroscky. Among the pupæ were 17 that were parasitized by a small chalcid, kindly determined for me by Mr. A. B. Gahan, as *Mormoniella brevicornis* Ashm. Some 204 specimens of this chalcid emerged between August 3 and 4 from these pupæ. Another bluebird's nest collected by Mr. J. D. Smith at Needham, Mass., contained 33 pupæ, from which emerged between August 3 and 5, 21 flies, all representing the form *sialia*. Of these 4 of the pupæ were parasitized by the above chalcid. The blood sucking larvæ of the Protocalliphora undoubtedly cause the death of many nestling birds. The above facts have been written up more in detail for an ornithological journal.

A large number on Hippoboscids on an Owl: On September 28, 1926, Dr. John C. Phillips captured a Great Horned Owl (*Bubo virginianus*) at Wenham, Mass. The specimen was sent to the Boston Society of Natural History and from it were taken 19 specimens of *Ornithopomus americanus* (Leach) and 34 *Ornithoica confluenta* (Say). Seven puparia of the latter species were also found. In skinning the owl Mr. J. D. Smith found six of the *O. confluenta* and three of the pupæ in the ears of the bird. These figures do not represent by far all the flies infesting the owl, as the cahuffeur said a number of the flies left the bird and were flying about the automobile on the way to the Museum.

Records for *Muscina pascuorum* Meigen, for 1926: Two males of this species were taken by the writer at Salisbury Cove,

Mt. Desert, Me., August 7 and 9, and four males and one female on Nantucket Island, Mass., Sept. 8, Mr. Howard J. Shannon reports finding eight in his attic at Jamaica, Long Island, N. Y., Oct. 22, 27 and 30. The two sent me were females. These figures show that in the late summer and early fall the males predominate, the females in October seeking buildings in which to hibernate. I am quite sure that this species covers a much greater area than has been recorded, but owing to its resemblance to other common muscids it has been overlooked. Mr. H. C. Curran has recently published (Can. Ent., vol. 58, p. 235) an account of the distribution of this fly in Canada.

THE FIRST RECORD FOR THE NARCISSUS FLY (*Merodon equestris*): IN AMERICA: There is apparently no doubt that this fly has been present in the immediate vicinity of Boston, Mass., for more than fifty years. The first record is that given by Packard.[1] who says:—"Mr. Sanborn has also reared from the pupa state *M. narcissi* which probably lives in the soil about decaying bulbs. It has been introduced from Europe according to Mr. Sanborn by the importers of Dutch bulbs." The fly was reared a year if not more before the publication of the work, 1869. Mr. F. G. Sanborn worked on the collection of insects at the Boston Society of Natural History at that time.

Osten Sacken in his Catalogue of Diptera 1878 says: "No American species are as yet recorded. The European *Merodon narcissi* has been occasionally introduced to the United States in dutch bulbs and the fly reared from them by Mr. F. G. Sanborn." Evidently at that time Osten Sacken had no record of the species having been taken afield and to this day the species is only found in close proximity to gardens which offer a suitable habitat.

The most interesting account of the Narcissis fly and its appearance in the vicinity of Boston is that by Professor J. G. Jack,[2] from which I quote the following: "In the Agassiz Museum Cambridge, Mass., there are larvæ of this pest and damaged bulbs of Narcissus which were received from a garden in Brookline, Mass. in 1879. During the past year or two this same es-

[1]Guide to the Study of Insects, p. 399, 1869.

[2]An enemy of Narcissus and Amaryllis, Garden and Forest, vol. X, p. 154-156, with figs. Apr. 1897.

tablishment has suffered more than usual damage from the ravages of the Merodon which appears to have been present in more or less abundance every season since it was first noticed in the place nearly twenty years ago. At that time besides various species and varieties of Narcissus, it was found to attack bulbs of *Vallota purpurea* and its varieties. Recently it has been found very destructive to many rare and beautiful Hippeastrum hybrids formerly known under the generic name of Amaryllis. And it is probable that it will be found to attack other plants of the Amaryllis family to which the Narcissus belongs. The pest has affected bulbs both in the open air and in the greenhouses." Although recorded by Banks in the "Bibliography of Economic Entomology," pt. 7, p. 50, 1901, this important paper on the history of this species in America seems since then to have been overlooked. A specimen in the Museum of Comparative Zoology bears the following label "From Hippeastrum bulbs in Greenhouse, Brookline, Mass., March 16, 1897, J. G. Jack." There is also a specimen from Prof. Jack in the collection of the Boston Society of Natural History. In 1902 I received from G. Chagnon for determination a specimen collected at Montreal, which was recorded in Aldrich's Catalogue in 1905. This record probably led Curran[3] to say, "The Species was first reported outside from Montreal." The later history of the species (1908-1916) is given by Dr. C. L. Metcalf (Ent. News, vol. 30, p. 173, 1919).

[3]Kansas Univ. Sci. Bull., vol. 15, no. 1, p. 169. Dec. 1924.

ON THE AFFINITIES OF THE GRYLLOBLATTIDÆ

By A. D. Imms, D. Sc.,

Rothamsted Experimental Station, Harpenden, England.

The family Grylloblattidæ includes two known genera viz. *Grylloblatta* Walk. (N. America) and *Galloisiana* Caudell (Japan). In its morphological characters it is evidently the most primitive living family of Orthopterous insects. Viewed from the phylogenetic standpoint, the Grylloblattidæ are of exceptional interest in that they combine features of the Orthoptera (*sensu lat.*) Isoptera, Dermaptera and Embioptera. Most of these characters have already been pointed out by Walker (1914) and in a series of papers by Crampton. The possession of a combination of "synthetic" characters, that are exhibited also in other groups, has rendered it difficult to settle the taxonomic position of the Grylloblattidæ and the affinities of the latter have consequently given rise to some divergence of opinion. In so far as the main characters are concerned, Walker considered that they are nearest allied to the family Blattidæ of the Orthoptera Cursoria. The present writer (1925) also maintained that the Grylloblattidæ are more closely related to the Cursoria than to the Saltatoria. On the other hand, Crampton in his most recent publication (1926) on the subject emphasises his previous opinion that the family should be placed along with the Orthoptera Saltatoria. In endeavouring to clear up the cause of this bone of contention it is useful to enumerate the principal characters that distingiuish these two main divisions of the old order Orthoptera and they are summarised below.

ORTHOPTERA CURSORIA. (Blattidæ and Mantidæ, together with the more distantly related Phasmidæ). Legs usually of approximately equal size and the hind pair not modified for leaping: tarsi 5-jointed. Sound producing organs wanting. Cerci most often multiarticulate, often with 8 to 15 or more joints. Ovipositor reduced and concealed. Penis asymmetrical.

ORTHOPTERA SALTATORIA (Orthoptera *sensu stricto*: Acridiidæ, Tettigoniidæ and Gryllidæ). Legs of unequal size,

the hind pair modified for leaping: tarsi never more than 4-jointed. Sound producing organs almost always present. Cerci never multiarticulate. Ovipositor well developed and almost always exserted. Penis bilobed and symmetrical.

On the characters enumerated above it may be said that the Grylloblattidæ only differ from the Cursoria in the possession of a well developed exserted ovipositor. It is, however, necessary to examine certain other criteria and not base a definite conclusion solely upon this diagnosis. Furthermore, several of the features stressed by Crampton in maintaining his point of view need some comment.

(1) Absence of ocelli. This character is of little phylogenetic value as ocelli tend to degenerate or disappear in various Orthoptera. Thus, among the Cursoria they are reduced or wanting in some apterous Blattidæ as well as being absent in many Phasmidæ. Their absence, therefore, is no criterian of affinity with the Saltatoria.

2; Multiarticulate cerci only occur in the Blattidæ and the related family Mantidæ. Unjointed setiform cerci are found in the Gryllidæ but there is no indication that this superficial similarity to the same, but multiarticulate, organs in the Grylloblattidæ is anything more than a parallelism, induced perhaps, by a similar terrestrial life.

(3) Dr. Crampton has already pointed out the structural similarity that exists between the terminal abdominal segments of the Grylloblattidæ and Mantidæ. He has likewise stressed the similarity of the coxæ, trochanters and divided trochantins, as seen in the Grylloblattidæ and Blattidæ, so no further comment here is needed.

(4) The various Isopteran characters displayed in the Grylloblattidæ, and emphasised by Crampton, afford indirect support to the relationship of that family with the Blattidæ. It is generally accepted by such competent authorities as Holmgren and others that the Isoptera are closest related to the Blattidæ on the sum total of their characters. Evidences of affinity of the Grylloblattidæ with the Dermaptera and Embioptera have very little bearing upon their systematic position within the Orthoptera.

(5) The Saltatorial affinities of the family are undoubted as Walker was the first to demonstrate. My contention is that they are insufficient to warrant its transference from the Cursoria. The most important character is the exserted ovipositor ot the Tettigonid type but here, as Walker has shown, it is constructed on a somewhat more primitive plan. The presence of the vaginal orifice between sterna 8 and 9 affords another character of the Saltatoria but is it also shared with the Phasmidæ. The general resemblance of the head to that of the Gryllidæ has been pointed out by Walker and subsequently by Crampton. The antennæ, on the other hand, show no such affinity and are definitely Embiid in character. The mouth-parts yield no decisive data although in some particulars they exhibit slight, but unconvincing, resemblances to those of the Gryllidæ.

(6) The full evidence of internal anatomy is at present unavailable but when Miss Ford's study of this aspect is completed we shall be in possession of data of considerable importance. Her recent study of the abdominal muscles (1924), however, indicates that the Grylloblattidæ betray Blattid and Mantid relationships rather than affinities with the Saltatoria.

In conclusion, it is hoped that the present article sufficiently explains the grounds for including the Grylloblattidæ as a family of the group Cursoria of the Orthoptera (*sensu lat.*) I wish to thank thank Miss Norma Ford for kindly supplying me with a well preserved example of the species *Grylloblatta campodeiformis*.

Literature.

Crampton, G. C.

1926. The Affinities of Grylloblatta indicated by a study of the Head and its Appendages. *Psyche*, vol. 32, pp. 78-85, (other papers by this author are listed here).

Ford, N.

1924. A Comparative Study of the Abdominal Musculature of Orthopteroid Insects. *Trans. Roy. Canad. Inst.*, vol. 14, pp. 207-319: pls. 7-23.

Imms, A. D.

1925. A General Textbook of Entomology. London. Methuen & Co., Ltd.

Walker, E. M.

1914 A new species of Orthoptera, forming a new Genus and Family. *Can. Entom.*, vol. 46, pp. 93-99.

1919. On the Male and immature state of *Grylloblatta campodeiformis* Walker. *Can. Entom.*, vol. 51, pp. 131-139.

1919, 1922. The Terminal Structures of Orthopteroid Insects: a Phylogenetic Study. *Ann. Ent. Soc. America*, vol. 12, pp. 267-316: vol. 15, pp. 1-76.

THE OCCURRENCE OF *FORMICA FUSCA* L. IN SUMATRA.

By William Morton Wheeler.

In a preceding number of Psyche (Vol. 29, Aug. 1922, p. 175) I cited the occurrence of two common North American ants, *Formica fusca* L. and *F. neogagates* Emery, as having been taken by Dr. J. W. Chapman at Dumaguete, on the Island of Negros in the Philippines, and conjectured that they might have been introduced by commerce. Recently I have come to doubt the provenience of the specimens to which I referred. It seems that when he left the Bussey Institution to teach at the Silliman Institute in Dumaguete, Dr. Chapman was supplied by our laboratory with a number of empty vials to be used in collecting ants and other insects. Possibly two of these vials contained some specimens of *F. fusca* and *neogagates* that had been collected near Boston by one of the students and had been accidentally included among the material amassed by Dr. Chapman near the Silliman Institute. Since all this material was collected in a small area he did not provide the individual vials with locality labels. Until, therefore, the species of Formica above mentioned are again taken at Dumaguete, it is inadvisable to include them among the Philippine ant-fauna. No such doubt, however, can arise in regard to the species of Formica discussed in the following paragraphs.

Among a number of ants collected for me by Dr. David Fairchild and his son Graham Fairchild in Northern Sumatra, I find a series of twelve workers, which evidently belong to the common circumpolar *Formica fusca*, though they may be regarded as representing a distinct variety, var. *fairchildi* var. nov. These specimens were taken by Dr. Fairchild March 8th, 1926 above Kota Dah, at an altitude of 4000 ft., in a pine forest. Careful comparison with many specimens of the typical *fusca* reveals only the following slight differences: Body averaging slightly smaller (4-5 mm.); funicular joints of the antennæ a little shorter. Border of petiole distinctly sharper and more compressed. Bristles on the flexor surfaces of the middle and

hind tibia stouter, less reclinate and more conspicuous. Pubescence much as in the true *fusca*, but finer and somewhat more dilute on the upper surface of the gaster, but distinctly longer on its sides and venter. The gaster is somewhat more shining and metallic, more as in the North American var. *subænescens* Emery. The color is a deeper black than in *fusca* and the legs and palpi are more blackish, the mandibles and antennæ somewhat deeper red. One of the specimens has distinct bluish reflections like the Mexican *F. subcyanea* Wheeler. The male and female, when discovered, will probably exhibit additional differences.

We must, I believe, regard the var. *fairchildi* as a true tropical relict and not as a recent importation. Its occurrence in a remote locality, at a considerable altitude and among pines makes the latter supposition very improbable. It is quite different from the var. *japonica* Motschulsky from Japan and China, a form which we might, perhaps, expect to find in Indonesia. The present wide distribution of *fusca* and its many varieties throughout northern North America and Eurasia, and its very close relationship, if not identity, with *F. flori* Mayr of the Baltic Amber (Lower Oligocene Tertiary) suggest an even wider distribution during the geologic past. Further investigations at high altitudes in Sumatra and possibly also in Java and Borneo may show that *fusca* has survived also in other localities in these tropical islands. A somewhat similar case is presented by *F. picea* Nylander, a peat-bog ant which is widely distributed over northern Eurasia and as far south as Switzerland and Thibet, though it is not known to occur in North America or Japan. In 1913 Forel described from Taihorin, on the island of Formosa, a variety of this ant (*formosæ*) which like the above described *fairchildi* would seem to be a tropical relict.

BURMESE ANTS COLLECTED BY PROFESSOR G. E. GATES.

By William Morton Wheeler.

In 1923 Professor Gordon E. Gates of Judson College, Rangoon, Burma, sent me a small but interesting series of Formicidæ which he collected in that locality. Most of the forms are well-known and widely distributed in the Indomalayan Region, but the collection includes a new species of Aphænogaster and a new variety of *Ænictus binghami* Forel.

Dorylinæ.

Dorylus (*Typhlopone*) *orientalis* Shuckard. A few soldiers and workers.

Ænictus binghami Forel var. *gatesi* var. nov.

Worker. Differing from the typical form of the species in having the pronotum entirely opaque and densely punctate like the remainder of the thorax. The petiole is also more coarsely punctate, more opaque and darker in color.

Numerous specimens from a single colony.

Ponerinæ.

Odontoponera transversa F. Smith. Several workers and a winged female.

Diacamma scalpratum F.Smith. Numerous workers.

Diacamma rugosum Le Guill. subsp. *vagans* F. Smith. var. *birmanum* Emery. Numerous workers.

Bothroponera bispinosa F. Smith. A few workers.

Ectomomyrmex astutus F. Smith. A few workers.

Euponera (*Brachyponera*) *luteipes* Mayr. Several workers.

Leptogenys (*Lobopelta*) *diminuta* F. Smith. A single worker.

Leptogenys (*Lobopelta*) *kitteli* Mayr. Several workers.

Pseudomyrminæ.

Sima rufonigra Jerdon. Several workers.

Tetraponera binghami Forel. A few workers.

Tetraponera allaborans Walker. A few workers.

MYRMICINÆ.

Aphænogaster (*Deromyrma*) **feæ** Emery.

Female (undescribed). Length 6.5-7 mm.

Resembling the worker. Cheeks with two parallel carinæ, instead of one, forming the external border of the antennal fovea. Mesonotum not overarching the pronotum, convex, as broad as long. Epinotum sloping, the base twice as long as the declivity, feebly concave, the spines stout, fully twice as long as their basal diameter, as long as the declivity, directed upward and backward. Petiole and postpetiole as in the worker, but their nodes higher and stouter. Gaster more voluminous than the thorax.

Sculpture, pilosity and color as in the worker, but the base of the epinotum coarsely and regularly, transversely rugose, the petiolar node transversely rugulose. Wings long, their membranes uniformly brownish, their veins and pterostigma darker brown.

Male (undescribed). Length 4.5 mm.

Head resembling that of the worker but shorter, the portion behind the prominent eyes less convex and narrowing more rapidly to the collar. Mandibles with a sharp apical tooth and five or six subequal basal denticles. Cheeks short and straight, without carinæ. Clypeus convex, its anterior border rounded and entire. Antennal scapes reaching a little beyond the posterior ocelli; funiculi slender, first joint longer than broad and distinctly thicker than the succeeding joints. Mesonotum strongly overarching the very short pronotum, very convex in front; epinotum long, the base long and sloping, strongly concave in front, horizontal and feebly convex behind, without spines or teeth, but with a distinct angle on each side where it passes into the very short declivity. Petiole and postpetiole as in the worker, but the nodes lower and that of the petiole more angular in profile.

Sculpture and color as in the worker and female, very smooth and shining, but the base of the epinotum and upper surface of petiolar node without rugæ. Hairs sparser, more

delicate and pointed than in the female and worker. Wings slightly paler than in the female.

Eleven workers, two females and four males from a single colony.

Aphænogaster (*Attomyrma*) **gatesi** sp. nov.

Worker. Length nearly 4 mm.

Head subrectangular, fully as broad as long, a little broader behind than in front, with straight, transverse posterior border and evenly rounded sides. Mandibles large, rather flat, with scarcely concave external borders, the teeth, except the apical, small, numerous and irregular. Clypeus broad, somewhat depressed anteriorly, the border entire, broadly and evenly rounded. Frontal area large, distinct and triangular. Frontal carinæ subparallel, nearly as far apart as their distance from the sides of the head. Eyes rather small, at the middle of the sides of the head. Antennæ moderately stout, scapes slightly flattened at the base, extending nearly half their length beyond the posterior corners of the head; funiculi with distinctly 4-jointed club; joints 2-7 subequal, about 1½ times as long as broad, basal joint nearly twice as long as broad. Thorax moderately stout but much narrower than the head, broadest through the pronotum which is subhemisperical, as broad as long. Promesonotal suture distinct and somewhat impressed; mesonotum narrow, sloping, with an abrupt angular projection on the middle and a lower angular projection at its posterior end near the mesoëpinotal suture. Mesoëpinotal constriction pronounced; base of epinotum straight and horizontal in profile, from above with a median longitudinal impression; declivity sloping, somewhat shorter than the base from which it is separated by a pair of small erect teeth which are as broad at the base as long. Petiole narrow, about twice as long as broad, laterally compressed, violin-shaped from above; the node rather small and conical. Postpetiole fully three times as broad as the petiole, as broad as long, broader behind than in front, the node in profile low and rounded, not as high as the petiolar node. Legs moderately long, femora distinctly thickened in the middle.

Shining: mandibles finely striate and sparsely punctate; clypeus with five widely separated longitudinal rugæ; cheeks and sides of head sharply but not densely longitudinally rugose; antennal foveæ with a few concentric rugæ; remainder of head and pronotum with scattered piligerous punctures; meso- and epinotum densely punctate-reticulate, but not opaque; nodes of petiole and postpetiole faintly longitudinally striate above; gaster and legs with scattered piligerous punctures.

Hairs yellowish, rather long, coarse but not obtuse, erect or suberect, both on the body and appendages, conspicuous on the scapes and legs.

Piceous brown; mandibles, funiculi, legs, borders of gastric segments and sutures of thorax and pedicel, except the nodes, paler and more reddish.

Described from four specimens.

This species is related to *A. smythiesi* Forel from the northwest Himalayas, but differs in the shape of the head and of the mesonotum, the angular projection of which is much further back in *gatesi*, the greater width of the postpetiole, very different sculpture of the head and epinotum, coarser, longer and more erect hairs on the appendages, etc.

Pheidole sulcaticeps Roger subsp. *yeënsis* Forel. Numerous soldiers and workers.

Pheidole malinsi Forel. Soldiers, workers and males.

Myrmicaria brunnea Saunders. Several workers.

Crematogaster dohrni Mayr. subsp. *rogenhoferi* Mayr. Workers and a deälated female.

Crematogaster hodgsoni Forel. Several workers.

Crematogaster rothneyi Mayr. Two workers.

Crematogaster (Oxygyne) travancorensis Forel. Several workers.

Solenopsis geminata Fabr. subsp. *rufa* Jerdon. Workers and females.

Pheidologeton affinis Jerdon. Soldiers, intermediates and workers.

Pheidologeton diversus Jerdon. Soldiers, intermediates and workers.

Carebara lignata Westwood. Two deälated females.

Meranoplus bicolor Guérin var. *lucidus* Forel. Three workers.

Dolichoderinæ.

Dolichoderus (*Hypoclinea*) *bituberculatus* Mayr. Three workers.
Dolichoderus (*Hypoclinea*) *affinis* Emery var. *glabripes* Forel. Numerous workers, a deälated female and four males.
Dolichoderus (*Hypoclinea*) *taprobanæ* F. Smith. Several workers and a deälated female.
Technomyrmex albipes F. Smith. Five workers.

Formicinæ.

Anoplolepis longipes Jerdon. Numerous workers.
Plagiolepis (*Anacantholepis*) *rothneyi* Forel. A single worker.
Œcophylla smaragdina Fabr. Numerous workers and a deälated female.
Camponotus (*Tanœmyrmex*) *variegatus* F. Smith var. *dulcis* Emery. Numerous workers and four females.
Camponotus (*Myrmosericus*) *rufoglaucus* Jerdon subsp. *paria* Emery. Numerous workers.
Camponotus (*Myrmosaulus*) *singularis* F. Smith. A single worker.
Camponotus (*Colobopsis*) *leonardi* Emery. Several workers.
Polyrhachis (*Myrma*) *proxima* Roger. Three workers.
Polyrhachis (*Cyrtomyrma*) *rastellata* Latreille. Five workers.
Paratrechina (*Nylanderia*) *birmana* Forel. A single worker.

NEW WEST INDIAN MEGACHILE.[1]

By Theodore B. Mitchell.

The following new species were found partly in a series of *Megachile* collected in Cuba by Dr. George Salt during the winter and spring of 1925, and partly in some unidentified material in the collection of the Museum of Comparative Zoology at Cambridge.

Megachile bahamensis n. sp.

♀. Head very broad, eyes slightly converging below, pubescence fuscous; supraclypeal plate almost impunctate medially, with only a few scattered punctures; clypeus coarsely and irregularly punctate, rather sparsely so in the center, apical margin polished and impunctate, somewhat thickened and very slightly incurved; mandibles broad, irregularly and very sparsely punctate above, 5-dentate, the two apical teeth approximate, and the three inner ones approximate, the second and third widely separated and with a cutting edge between them which ends abruptly just before the subapical tooth; cheeks narrow, shining, finely punctate, carinate on posterior margin; vertex flat, shining, with a few larger scattered punctures interspersed with more numerous smaller ones which are more shallow and indistinct; lateral ocelli about equally distant from eyes and edge of vertex; front sparsely punctate just below ocelli, but closely and finely punctate between antennæ; antennæ blackish above, pale brownish beneath with a slight violet tinge, the middle joints slightly longer than broad.

Thorax entirely bare above, pubescence at sides and behind brownish, becoming fuscous below; mesonotum shining, with large scattered punctures, almost impunctate medially; scutellum impunctate medially, with scattered punctures laterally, posterior margin broadly triangular; pleura closely and finely

[1]Contribution from the Department of Zoology and Entomology, North Carolina State College, in cooperation with the Entomological Labaratory of the Bussey Institution, Harvard University [Bussey Institution No. 271]. Published with the approval of the Director of the North Carolina Experiment Station as paper number 14 of the Journal Series.

punctured above, more coarsely and sparsely so below; propodeum very finely and closely punctured laterally, more sparsely so posteriorly; tegulæ piceous, finely punctured, the punctures widely separated; wings pale fuliginous, more strongly so apically and along costa, nervures testaceous, basal nervure much beyond transverse median, second recurrent nervure entering second submarginal cell slightly nearer apex than the first does to the base; legs black, black pubescent, that on the tarsi beneath and on the mid tarsi without, with somewhat of a fuscous tinge; middle metatarsi almost as broad as their tibiæ and the hind metatarsi fully so; spurs reddish-testaceous; claws testaceous basally, ferruginous apically, with short but distinct basal teeth.

Abdomen cordate, shining, segments with but few scattered punctures apically, but more numerous on basal portions of discs, bare of pubescence above, the concavity of the first segment peculiar in having a longitudinal sharp ridge dividing it into two separate concavities; segment 6 but very slightly concave at sides viewed from above, practically straight in profile, the surface hidden by fine appressed brownish pubescence, which contrasts rather strongly with the otherwise black abdomen; scopa entirely black; apical ventral segment with a free polished apical lip which projects slightly beyond the scopa. Length 11 mm.

Type: Female (Type No. 15716, Mus. Comp. Zool.); Mangrove Cay, Andros, Bahamas, Aug. 1, 1904 (Allen, Barbour and Bryant, collectors).

This is close to *M. maura* Cress. but differs in the color of the pubescence, in the double punctation of the vertex, and in the peculiar ridged condition of the concavity of the first abdominal segment. In *maura* the pubescence is deep black, the vertex has only a few scattered punctures and no evidence of double punctation and the basal concavity is normal.

Megachile poeyi alleni n. subsp.

♂. Head broad, eyes slightly converging below, pubescence mostly white, short and blackish on vertex; clypeus closely punctured, apex beneath beard entire, shining; mandibles 4-

dentate, apical portion reddish except the teeth, very finely punctate, rounded on outer margin viewed from above, inferior tooth basal; cheeks about as broad as eyes, punctures shallow and indistinct, densely pubescent on lower angle, thinly so above; vertex flat, deeply punctured, the punctures close behind ocelli, otherwise well separated; lateral ocelli slightly nearer edge of the vertex than to nearest eye; front below ocelli very densely punctured; antennæ long, the joints fully twice as long as wide, piceous above, red below, apical joint not much modified.

Thorax very densely and finely punctured above, the punctures coarser and well separated on pleura below, sparse on the sternum, pubescence whitish on the sides, behind and beneath, apparently black on mesonotum (specimen rubbed) with large anterior patches of dense pale pubescence, and probably margined laterally and behind with dense pubescence of the same color in fresh specimens; tegulæ piceous, very densely and finely punctate; wings fuliginous, nervures brownish to testaceous, second recurrent nervure entering the second submarginal cell somewhat nearer apex than first does to base.

Legs piceous, all the tarsi ivory color; front coxæ with rather stout but flattened spines, front trochanters reddish-testaceous beneath; front femora strongly keeled beneath apically, the punctate portion of the posterior face much reduced, confined largely to the apical half of the femur, with a short sharp carina on upper margin at center, ferruginous, the lower margin at the keel ivory color, the upper face reddish-testaceous, polished, antero-inferior face also polished, paler testaceous, margined at sides with ferruginous and with a median longitudinal stripe of the same color extending from the base about half way to apex; outer face of front tibia piceous and punctate, the posterior margin carinate, the other two faces polished and testaceous, the anterior one more reddish; anterior tarsi broadly dilated, the basal joint only slightly longer than wide, hollowed out anteriorly, the two anterior margins fringed with short yellowish pubescence, the remaining joints gradually narrowed to tip, the fifth not dilated but quite flat and parallel-sided, very slightly darker apically; tarsal fringe white, brownish apically, largely

brownish beneath, second joint with a large black spot beneath; middle and hind tarsi not dilated but distinctly ivory colored.

Abdomen somewhat parallel-sided, finely and closely punctured, black pubescent, the pubescence of segment 1 entirely white, and segments 1-5 with entire white apical fasciæ; segment 6 with dorsal surface vertical in position, rugoso-punctate above the carina, the carina with a conspicuous rounded emargination, otherwise entire, apical margin slightly carinate on either side of middle, and with a small but sharp lateral tooth on each side beyond the carina; four ventral segments visible, these shining and sparsely punctured. Length 9 mm.

♀. Head broad, eyes slightly converging below; supraclyeal plate and clypeus coarsely punctate, rather sparsely so medially, the clypeus with an impunctate median line, the apical margin slightly denticulate, pubescence very thin and pale; mandibles broad, reddish apically, sparsely punctate above, conspicuously 4-dentate, a straight cutting edge between the two inner teeth, and another between the two middle teeth, the latter ending abruptly about half way between them; cheeks narrow, closely punctate and quite densely pubescent, the pubescence yellowish-white; vertex flat, deeply punctured, the punctures well separated, pubescence black; lateral ocelli much nearer the edge of the vertex than to the nearest eye; front below ocelli densely punctate; antennæ piceous above, red below, the middle joints slightly longer than broad; pubescence yellowish-white on face, some short inconspicuous black hairs on supraclypeal area.

Thorax black pubescent above, pale ochraceous at sides, below and behind; mesonotum finely punctate, punctures separate medially, close laterally and posteriorly, with two lateral anterior patches of dense ochraceous pubescence, a spot of the same color just back of the tegulæ, and the scutello-mesothoracic suture lined with it; scutellum long black pubescent across middle, with short dense pale pubescence behind, finely and rather closely punctate; pleura closely and finely punctate above, more coarsely and sparsely so below; propodeum granular, punctures indistinct; tegulæ black, closely and finely punctate; wings pale fuliginous, somewhat darker apically, nervures yellowish brown, the second recurrent nervure entering the second

submarginal cell nearer apex than the first does to base; legs piceous, all the tarsi ferruginous, pubescence whitish, yellow on all the tarsi beneath and on the middle metatarsi without; spurs pale yellow; claws testaceous basally, ferruginous apically, with sharp basal teeth.

Abdomen ovoid, finely and closely punctured, black pubescent, the pubescence on the first segment entirely pale ochraceous, and segments 1-5 with entire and conspicuous apical fasciæ of pale ochraceous pubescence; segment 6 rather distinctly concave at sides viewed from above, straight in profile, with greyish appressed pubescence, that on the basal middle dark brown, with rather short black erect hairs at sides basally; scopa white, black on segment 6, with a considerable amount of black at sides of segment 5, and with a small amount at sides of segments 4 and 3; apical ventral segment with a free polished apical lip which projects slightly beyond the scopa. Length 11 mm.

Type: Male (Type No. 15715, Mus. Comp. Zool.); Mangrove Cay, Andros, Bahamas, Aug. 1, 1904. Allotype; topotypical (Allen, Barbour and Bryant, collectors).

This is probably only a subspecies of *M. poeyi* Guer. from which it differs as follows: The male is smaller (11 mm. in *poeyi*) and the legs above the tarsi are piceous (bright red in *poeyi*); the pubescence on the disc of segment 2 is entirely black, whereas in *poeyi* it is entirely ochraceous, and the pale pubescence is nearly white, while in *poeyi* it is strongly ochraceous; in the female the apical margin of the clypeus is less strongly denticulate and the vertex is somewhat less closely punctured than in *poeyi*, and the bright red legs of the latter at once distinguish it from this form; and there is considerably more black pubescence in the scopa of the subapical segment in *poeyi*, being black almost entirely across the segment apically.

Megachile salti n. sp.

♀. Head broad, eyes converging slightly below, vertex broad and flat; supraclypeal plate shining and bare, finely tessellate, impunctate medially, closely punctate laterally; clypeus with a rather broad impunctate median area, but rather closely

punctate laterally, apical margin slightly concave medially, with a slight median tubercle, pubescence white with a faint ochraceous tinge, and with a few long black hairs laterally; mandibles broad, 4-dentate, the third tooth truncate, almost impunctate and tinged with red above, with fine close punctures at base in front, with a distinct line above leading from the incision between the two apical teeth almost to the base; cheeks very narrow, carinate posteriorly, rather finely punctate, and entirely white pubescent; vertex very short, sparsely punctate, being almost impunctate between the eyes and ocelli, with conspicuous, rather long, erect black pubescence; ocelli much nearer edge of vertex than to nearest eye; front below ocelli closely punctate, with mixed black and white pubescence; antennæ black above, more piceous below; pubescence white on inner orbits, and around and between the antennæ.

Thorax mostly white pubescent below and at sides; mesonotum sparsely punctured medially, more closely so around the margin, rather dull, pubescence black in general, but pale ochraceous anteriorly, with two conspicuous anterior oblique lines of white pubescence, and a very conspicuous line of short whitish appressed pubescence in the suture between the mesonotum and scutellum, reaching across from one tegula to the other; scutellum finely and closely punctured, with pubescence entirely black, contrasting with the white pubescence just below on the narrow metanotal plate and propodeum; pleura rather closely punctured, white pubescent, but with a round spot of black pubescence just beneath the wings; propodeum tessellate, with scattered very fine punctures, basal triangle impunctate, tessellate; tegulæ blackish, finely punctured, with a tuft of white pubescence in front; wings subhyaline, slightly infuscated apically, nervures blackish, basal nervure beyond transverse median, second recurrent nervure entering second submarginal cell nearer apex than the first does to base; legs white pubescent, that on the tarsi beneath brownish; all the coxæ black, trochanters black to obscure red, all the femora and tibiæ bright red, all the tarsi deep black, contrasting strongly with the tibiæ and femora, hind metatarsi very broad and rather short; claws yellowish basally,

ferruginous apically, without distinct basal teeth; spurs pale yellow.

Abdomen cordate, flattened above, the segments not very deeply impressed basally and not at all apically, finely punctate, shining, with short black pubescence on the discs except on segment 1 where it is long and white; segments 1-5 conspicuously white fasciate, all the fasciæ entire, but rather narrow basally; segment 6 slightly concave at sides viewed from above, also slightly concave in profile, with appressed, very dark brown pubescence, and with scattered erect black hairs basally; scopa pure white, mostly black on segment 6, and black at extreme sides of segments 3-5.

Length 10 mm.

♂. Head broad, much as in the female, pubescence dense and ochraceous; clypeus closely punctured, densely pubescent, with a considerable amount of black hair above and at sides, apical margin beneath the beard smooth and shining, broadly emarginate or incurved medially; mandibles 4-dentate, shining above, with a few scattered black hairs in front, inferior tooth subbasal, rather small, sharply pointed; cheeks and vertex as in the female, the cheeks simple below (not excavated nor toothed); antennæ long, the joints more than twice as long as wide, black above, more piceous below; pubescence somewhat longer on vertex than in the female.

Thorax with pubescence arranged as in the female, but rather longer above; tegulæ and wings as in the female; legs much as in the female, but the femora suffused with blackish basally; front coxæ black, thinly pubescent in front, with flattened curved pointed spines of moderate length; front tarsi simple, with hardly any fringe, with long mixed black and white hairs; front tibiæ with black pubescence on outer face; pubescence on front tarsi beneath brownish, pale yellowish on the middle and hind tarsi beneath, legs otherwise white pubescent.

Abdomen somewhat narrowed posteriorly, shining, punctures very fine and rather sparse; pubescence long and pale on segment 1, black on discs of segments 2-4, segments 3 and 4 with basal fasciæ, 5 broadly appressed pubescent basally, the pubescence pale ochraceous, the surface otherwise with rather long

erect black hairs; apical fasciæ poorly developed, represented by mere tufts of whitish pubescence at extreme sides of segment 1, and widely interrupted on segments 2-4; segment 5 without an apical fascia; segment 6 with a low inconspicuous carina, which is broadly, shallowly and evenly emarginate medially, otherwise entire, the segment above the carina with ochraceous appressed pubescence and scattered long erect black hairs; morphological apex of segment carinate on either side of the middle, the carina low and inconspicuous, extending to the lateral teeth which are vestigeal; segment 7 pointed; venter with three unmodified visible segments, which are fringed with white hair apically, the fourth segment visible, but membranous and transparent, considerably modified from the usual condition. Length 8 mm.

Type: Female (Type No. 15706, Mus. Comp. Zool.); Soledad, Cuba, May 22, 1925. Allotype; Mina Carlota, Trinidad Mts., Cuba, 1500 ft. altitude, on flowers of *Neurolæna limbata*, March 25, 1925. Paratypes: 2 females; Mina Carlota, March 25, on *Neurolæna*; 1 female, Soledad, June 1, on flowers of *Parkinsonia aculeata*; 1 female, Soledad, June 20, on flowers of *Psidium cattleyanum*; 2 males, Mina Carlota, March 25, on *Neurolæna*, and 1 male, Soledad, June 20. All of the series collected by Dr. George Salt. Two of the paratype males, one from each of the localities cited, vary from what has been designated as the type form in having entirely black legs, and with the pubescence more nearly pure white.

In general form, and in structure of the clypeus, mandibles, cheeks and vertex in both sexes, and in the form of the apical abdominal segment in the male, this species closely resembles *M. petulans* Cress. to which it is evidently very closely related. The cheeks are slightly narrower than in *petulans* however, and the clypeus is less strongly and closely punctured in the female. In the male the carina of segment 6 is much less deeply emarginate, and the fourth ventral segment is modified. The color of the pubescence and the red femora and tibiæ at once distinguish them, however. Of the Cuban species, this superficially resembles *M. poeyi* Guér. but here again the color of the legs will serve to distinguish them.

Megachile carlotensis n. sp.

♂. Facial quadrangle much longer than wide, densely ochraceous pubescent; clypeus closely and finely punctured, apical margin smooth and shining, slightly incurved; mandibles 4-dentate, obscurely reddish apically, otherwise black, inferior tooth triangular in shape, submedian, somewhat nearer base of mandible than to apex; cheeks broad, closely punctured, carinate posteriorly; vertex considerably extended behind eyes, flat, closely and quite deeply punctate posteriorly, an impunctate area on either side of the lateral ocelli, and a small oval impunctate area between them, the posterior margin of the vertex definite but hardly carinate; ocelli considerably nearer eyes than to edge of vertex; antennæ not especially long, the joint being hardly twice as long as wide, the apical joint dilated and somewhat flattened; pubescence of face and clypeus ochraceous, tinged with red on vertex, some short black hairs above eyes on vertex, pubescence short and white on middle of cheeks, cheeks below with large patches of pale fulvous hair, and the inferior angle just below with long dense white pubescence, while just behind the inferior mandibular tooth is a small excavation densely covered with pale ochraceous pubescence, and the gular region back of this has long dense pale ochraceous pubescence.

Thorax with pubescence ochraceous above, paling to white below, a patch of fuscous pubescence in center of mesonotum; mesonotum strongly and closely punctured; scutellum with a median longitudinal impunctate area, with strong punctures on either side, but not so closely punctured as the mesonotum, with hair all pale; pleura closely punctured; propodeum shining behind, where it is almost bare, laterally minutely roughened and quite densely pubescent, basal triangle tessellate and impunctate; tegulæ piceous, minutely punctate, pubescent basally and anteriorly; wings fuliginous, considerably darker apically, violaceous, nervures ferruginous, basal nervure beyond transverse median, second recurrent nervure entering second submarginal cell nearer apex than the first does to base; hind wings hyaline.

Middle and hind coxæ, trochanters and femora black, the

tibiæ bright ferruginous, the tarsi yellowish-ferruginous; middle tibia without the usual spur, the metatarsus as long as the tibia, narrow, somewhat curved, and densely yellowish pubescent exteriorly; hind tibia with spurs pale yellow, the metatarsus short, and rather thick and wide; front coxæ black, bare in front, thinly pubescent behind, and with a dense patch of white pubescence on outer side, with short flattened triangular pointed spines and with a patch of red bristles to one side and in front of the spines; trochanters black, fringed posteriorly with pale hairs, and with considerable black pubescence intermixed apically; front femora reddish-yellow, piceous above on apical third, sharply keeled beneath on slightly more than the apical half, pubescence whitish, pale ochraceous basally, and with a few black hairs below at extreme base; front tibiæ ferruginous, shining and deeply punctate on outer face, where the pubescence is short, sparse and pale yellow, the two inner faces polished and more yellowish, a fringe of short reddish pubescence on the edge between these two faces; spur large, hollowed out, reddish-yellow; front tarsi enormously dilated, pale yellow to whitish, the second joint somewhat longer than the first at base, but the first expanded and lengthened into a large hollow scale in front, the second produced as far as the tip of the metatarsal scale, but not much lengthened, the third with a small process in front, the fourth small, the second and third joints are not hollowed out but merely expanded anteriorly; the tarsal joints are fringed behind with long pale ochraceous hair, this tipped within with dark brown; anteriorly the first joint has a fringe of long reddish-brown stiff hair, and the inner margin of the scale has a short paler fringe; the second and third joints are covered within with reddish-brown bristles, and the second joint has also a definite fringe of reddish-yellow pubescence at the tip exteriorly; all the claws are ferruginous basally, piceous apically, the second and third pair deeply cleft, those on the front legs with a rudimentary inner tooth.

Abdomen oblong, parallel-sided, shining, punctures distinct but rather fine, well separated; segments 1 and 2 with rather long ochraceous pubescence, a few black hairs on the second apically; segments 3 and 4 with black pubescence on the discs

and with conspicuous basal ochraceous fasciæ; segment 5 covered, except the apical margin, with ochraceous appressed pubescence and with scattered erect pale hairs; none of the segments with apical fasciæ except at extreme sides of segments 2-4; segment 6 finely rugoso-punctate, the carina low and inconspicuous, broadly emarginate, so that the two teeth are all that is left, the segment above the emargination bare, on either side the surface covered with dense appressed ochraceous pubescence, morphological apex of the segment slightly carinate at the sides and with small lateral apical teeth; segment 7 broadly rounded, flat below, carinate apically, the carina projecting very slightly beyond the sixth segment medially; venter with four visible segments, the first three fringed behind with white hair, the fourth with an ochraceous apical fringe. Length 11.5 mm.

Type: Male (Type No. 15705, Mus. Comp. Zool.); Mina Carlota, Trinidad Mts., Cuba, 1500 ft. altitude, on flowers of *Neurolæna limbata*, March 25, 1925 (Geo. Salt, coll.).

Although the superficial resemblance is very slight, due to the color of the pubescence and legs, this insect is very similar in structure to *M. xylocopoides* Sm. and *M. morio* Sm., especially to the latter. It seems hardly possible that this can be the male of *M. maura* Cress. which belongs to the *xylocopoides-morio* group, although it was caught at the same time and place as females of *maura*. *M. sedula* Sm. belongs to this same group, however, and the color of the pubescence and of the scopa suggests the possibility that this is the male of that species. *M. sedula* is recorded from St. Domingo, but may possibly occur on the island of Cuba. If this is not *sedula* it is at least a close relative.

Records of other species of *Megachile* in this series follow:

Megachile maura Cress.

6 ♀♀: Mina Carlota, near Cienfuegos, Cuba, March 21-24, at *Neurolæna*.

Megachile poeyi Guér.

7 ♂♂, 15 ♀♀: Mina Carlota, March 22-25; La Milpa (near Cienfuegos, at practical sea level), June 24 and July 4; Soledad, February 14, 22 and 23, April 6 and 10, June 9-29: on flowers of *Neurolæna limbata*, *Vernonia neuthæfolia*, *Psidium cattleyanum* and *Caseria aculeata*.

Book Notice.

The Heteroptera or True Bugs of Eastern North America by W. S. Blatchley. 1116 pages, 215 figures, 12 plates. 1926. The Nature Publishing Company, Indianapolis.

This is another hegemonic work on American insects by W. S. Blatchley, to whom entomologists are already indebted for his previous books on the Coleoptera, Orthopetra and Rhynchophora written in collaboration with Mr. Chas. W. Leng. Containing as it does, descriptions and keys to over 1200 species, it fills a need that was only partly supplied by the Hemiptera of Connecticut and is a tribute to Mr. Blatchley's skill, knowledge and determination. With this manual the study of the Heteroptera should be greatly accelerated, as it is now no longer necessary for the student, unless he is a specialist and disagrees with some of Mr. Blatchley's opinions, to wade through the scattered literature in order to identify his species. Mr. Blatchley says his manual "has been prepared mainly for the use of the tyro," but we are all abecedarians outside of our own, usually restricted, fields. When the author deviates from the tracks of his predecessors, this is noted either in the text or footnotes, with reasons. In addition to the descriptions and keys, numerous notes deal with habits, food plants, localities, dates and general distribution, special attention being given to the Heteropterous faunas of Indiana and Florida. With the exception of some thirty pages devoted to external structures, general habits, methods of collecting, etc., the entire work is a descriptive catalogue of the order, a broad survey covering the entire field. In these days of intense specialization few entomologists become proficient in even the classification of a single order of insects and all the more credit is due Mr. Blatchley for the successful culmination of what at times, must have declined, in spite of his professional interest, into mere drudgery. Systematic entomology will always appear chaotic and uninspiring to the uninitiated until there are more works of this kind, leading into the wilderness of literature and opinions.

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